Review Article



A Review of the Prevention and Treatment of Hypertrophic Scars: Part I Clinical Aspects

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Abstract

The therapeutic management of hypertrophic scars remains challenging. Numerous methods have been described for the treatment of hypertrophic scars but, to date, the optimal treatment method has not been established. The aim of this review is to discuss the therapeutic modalities in the light of current literature, and to guide regarding the choice of treatment methods for physicians. The surgical and non-surgical treatment and prevention methods of the hypertrophic scars were reviewed and some recommendations for physicians who try to treat or prevent the hypertrophic scar were developed under cover of current literature and our personal experiences. A lot of therapeutic modalities have been described for the hypertrophic scars so far, but there is no absolute curative method alone. The most appropriate method or methods should be selected according to the patient's needs and properties of the scar. The therapists can benefit from our review when they select the most appropriate method or methods for treatment of hypertrophic scars.

Key words: Hypertrophic scar, prevention, treatment

Introduction

Hypertrophic scars are abnormal scars that develop after wound healing, especially in individuals of African, Hispanic, and Asian descent [1]. Hypertrophic scars consist of an abundance of scar tissue confined to the original wound site. They usually develop 6 to 8 weeks after reepithelialization, and a period of at least 6 to 18 months is required for their maturation [2]. Hypertrophic scars can be painful, pruritic, erythematous, raised, and cosmetically unacceptable.

The therapeutic management of hypertrophic scars remains challenging. Numerous methods have been described for ¹Department of Plastic Reconstructive and Aesthetic Surgery and Burn Unit Gulhane Military Medical Academy Haydarpasa Training Hospital Istanbul, Turkey

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Corresponding author: Dr. Cihan Sahin Department of Plastic and Reconstructive Surgery Kasimpasa Military Hospital 34444 Kasimpasa Beyoglu, Istanbul, Turkey dr.cihansahin@gmail.com the treatment of hypertrophic scars but, to date, the optimal treatment method has not been established [3]. Several treatment modalities exist, such as surgical excision, intralesional injections, application of silicone products, pressure garments, laser therapy, cryotherapy, and various topical and oral medications [4].

The most important problem encountered is a lack of large-scale randomized, controlled trials for the assessment of effectiveness of the treatment methods. The major cause of this deficiency is that all scars improve with time and creating an exact control group is almost impossible. Therefore, most modalities are applied on the basis of the treating physician's personal bias and experience.

The aim of the first part of this extensive review is to discuss the surgical and non-surgical therapeutic modalities in the light of current literature, and to guide regarding the choice of treatment methods for physicians who try to treat the hypertrophic scar.

Surgical Treatment

Before anything else, careful wound care and meticulous surgical repair of the wound are very important for the reduction of hypertrophic scar risk. The first step in minimizing scarring should be attention to the early care of wounds. It should achieve the rapid epithelialization of minor wounds within 10-14 days by using ointment or semiocclusive dressings, because the incidence of hypertrophic scarring goes up dramatically after 14 days [5]. In addition, meticulous wound management with efforts to prevent infection is mandatory. Surgical closure of an open wound should be carried out without tension.

Surgical excision combined with steroids, surgical taping, and silicone gel sheeting can be used effectively for treatment of hypertrophic scars, which result from excessive tension or wound complications, such as infection or delay in healing [4]. Surgical closure should be performed with intradermal sutures for at least 6 weeks for preventing tension. Suture materials should be chosen according to the site of application, and non-absorbable sutures are more suitable for high skin tension sites, such as the anterior chest wall [6].

The indications for surgical treatment are not clearly delineated. Hypertrophic scars with joint contractures could result in functional dysfunction, and surgery is indicated. Releasing of the scar contractures improves joint function and also accelerates the maturation of surrounding immature scars and hypertrophic scars [6]. Small and linear hypertrophic scars can be treated by complete surgical resection or non-surgical multimodal therapy. The goals of excisional scar revision are to redirect the scar, divide it into smaller segments, and make it level with the adjacent skin [7]. In these cases, a type of tension-releasing technique, which includes Z-plasty, W-plasty, and small wave incision, should be applied to prevent the recurrence of hypertrophic scars [6,8,9].

Non-surgical Therapies

Although surgical intervention is compulsory in the case of hypertrophic scars, which cause contracture of joints, hypertrophic scars without scar contractures should be treated by one or more of the multiple nonsurgical therapies available, especially the non-invasive therapies [6].

Pressure Garments

Pressure therapy became popular after the reports from Larson et al. in the 1970s, and it has been the mainstay of hypertrophic scar treatment and currently is the standard first-line therapy for hypertrophic scars in many centers [10-12]. To date, the mechanism of pressure and the way pressure positively influences the maturation of hypertrophic scars are not fully understood, but there are some hypothetical explanations [10,13,14]. Reid et al. suggested that pressure reduces collagen production to the levels found in normal scar tissue more rapidly than the natural maturation process [15]. According to other articles, pressure therapy controls collagen synthesis by limiting the supply of blood, oxygen, and nutrients to the scar tissue, and it encourages realignment of collagen bundles already present [13,15-17]. All these effects may hasten scar maturation, reducing the incidence of contractures and negating the need for surgical intervention [10].

Recent systematic review and meta-analysis of pressure garment therapy concluded that the beneficial effects of pressure garment therapy remain unproven [18,19]. However, in their most recent study, Steinstraesser et al. compared the safety and efficacy of pressure garment therapy alone as well as in combination with silicone gel sheeting or silicone spray therapy for

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the prevention of hypertrophic scarring. They demonstrated that silicone (silicone gel sheet or silicone spray) with pressure garment therapy and pressure garment therapy alone for 1 year were all associated with significant improvement of the Vancouver Scar Score and the sub-scores for pliability, height, and vascularity at the 18-month endpoint of their study. In addition, there was a significant improvement in itching and pain in all tested wounds. The intraindividual comparisons (silicone therapy versus pressure garment therapy) resulted in no major statistically significant differences. In other words, the use of pressure garment therapy alone produced results equivalent to those of combined silicone and pressure garment therapy in the prevention of hypertrophic scars. Given the current evidence and the paucity of long-term, good-quality, prospective, randomized, controlled trials with intraindividual comparison, this trial is a valuable addition to the evidence base for the prevention of hypertrophic scarring [18].

It is generally recommended that pressure be maintained between 24 and 30 mmHg for 6 to 12 months for this therapy to be effective [4]. Many problems are associated with the use of pressure garments, such as poor compliance with treatment, discomfort from heat and perspiration, swelling of extremities, eczema, rashes, pruritus, blistering, ulceration, and scar breakdown [14,15,20-23]. To optimize pressure therapy further, studies should definitely be undertaken to examine the changes in pressure under dynamic circumstances, the effects of pressure on the local vector forces in the skin, and the optimal timing and duration of pressure therapy [10].

Silicone Materials

Silicones are synthetic polymers based generally on a dimethyl siloxane monomer and containing a silicon-oxygen backbone, with organic groups attached directly to the silicon atom by silicon carbon bonds [10]. Depending on the length of the polymer chain and the degree of cross-linking, the silicone can be a fluid, gel, or rubber [24]. The therapeutic effect of silicone is not only due to pressure, but also an increased static charge and wound hydration. It also suggested that silicone sheeting may act by down-regulating fibroblast, decreasing fibrogenic cytokines, such as TGF β 2 [10,25] and modulating growth factors that orchestrate the tissue repair process, such as the expression of the basic fibroblast growth factor (bFGF) [10,26,27].

Eishi et al. reported that examining the effect of commercially available silicone gel sheeting (Cica-Care, Smith & Nephew, Memphis, TN) on six patients noted the disappearance of pain and pruritus after 12 weeks, which may be attributed to a decrease in the number of mast cells and the enhanced expression of Fas antigen by lesional fibroblasts after 24 weeks of treatment in one of the patients [28,29]. In a separate study with silicone gel sheeting, Santucci and colleagues [28,30] obtained biopsies from hypertrophic and keloid scars at baseline and at 12 weeks. After silicone treatment, they observed a reduction of spindle-shaped cells and an increased number of lymphocytes that strongly expressed CD11a/CD18 (LFA-1) adhesion molecules. As mentioned earlier, results from other in-vitro studies suggest that silicone sheeting may act by downregulating fibrogenic cytokine TGF-β2 or increasing bFGF and IL-8 levels [10,25,27,28,31]. Non-silicone occlusion studies of clinically normal skin are of equal importance and have found increased levels of epidermal mononuclear cells and morphologic alterations in the Langerhans cells after occlusion [28,32-33].

Silicone gel and silicone gel sheeting has been widely used in clinical practice for treatment or prevention of hypertrophic scar. Silicone gel was used initially for scar treatment rather than prevention [34]. However, the introduction of "the adhesive technique" over the past few years has allowed for earlier therapy with the aim of preventing or minimizing scar hypertrophy with better short- and long-term cosmetic results, while causing limited damage to the stratum corneum at removal, as compared to non-adhesive silicone gel dressings [10].

Silicone Gel

Silicone gel does not require fixation and it is invisible when dry [35]. It could be used for scar treatment, especially in visible areas [36]. In our previous study, we compared the efficacy of silicone gel and silicone gel sheeting for the treatment of post-burn hypertrophic scars, and we found that there was no statistically significant difference between silicone gel and silicone gel sheeting for treatment of hypertrophic scarring, although the effect of silicone gel sheeting is slightly higher than silicone gel [35]. We suggested that silicone gel could be used for treatment of hypertrophic scarring. Some other studies about the comparison of silicone gel and silicone gel sheeting for treatment of hypertrophic scars were carried out and the authors of them reported that there was no significant difference in efficacy between the two forms of silicone dressing [26,37,38].

Silicone Gel Sheeting

There is good evidence of efficacy of the silicone gel sheeting, and it has now become standard care for plastic surgeons [4]. Results from at least eight randomized, controlled trials and a meta-study of 27 trials [39] demonstrate that silicone gel sheeting is a safe and effective management option for hypertrophic scars [4,28,35,38,40-42]. The application of silicone gel sheeting in a variety of settings appears to result in flattening, softening, and increased pliability of the scar [10]. Li-Tsang et al. reported that silicone gel sheeting helps to reduce the thickness, pain, itchiness, and rigidity of hypertrophic scars in their prospective clinical trial [43]. Gold et al. reported that topical pure silicone gel sheets are a useful modality in the prevention of hypertrophic scars in patients undergoing scar revision [44]. Majan et al. also reported that patients treated with soft silicone dressings showed greater and more rapid improvement in hypertrophic scar maturation than untreated patients [45]. In our previous study, we demonstrated that silicone gel sheeting is effective for treatment of hypertrophic scars, and we suggested that if there is no factor that impedes application, silicone gel sheets should be preferred for treatment of hypertrophic scars instead of silicone gel [35].

It has recommended that silicone gel sheeting be in contact with the scar for 12 to 24 hours per day for 2 to 3 months, with removal permitted for routine hygiene. Possible drawbacks to silicone gel include patient noncompliance (especially children) and adverse events, such as pruritus, rashes, skin breakdown, maceration, and odor, can be managed by temporary interruption of treatment and regular washing of the sheet and the scar [7].

Intralesional Injections

Since the mechanism underlying the scar formation substantially related with fibroblast activation and excessive collagen production, antimitotic drugs that mainly target the fibroblasts in scar tissue can be used intralesionally for prevention and treatment [1]. The current antimitotic drugs used in scar treatment are Corticosteroids, 5-fluorouracil, Bleomycin, Mitomycin C, and Retinoic acid.

Corticosteroid

Triamcinolone is the most common corticosteroid used for the scar treatment. It may be administered alone or in combination with lidocaine to reduce the pain associated with the injection [10]. The dosage has varied from 10 to 40 mg/mL, and several treatments at once or twice a month are usually required to achieve the desired results [46]. Corticosteroids decrease the production of inflammatory cytokines, adhesion molecules, lysosomal enzymes, and inhibit fibroblast proliferation [47]. Injections of intralesional steroids produce objective reductions in scar volume for significant numbers of patients, with improvement of scar pliability, height, and symptoms such as itching and pain [1,46]. Response rates vary from 50 to 100 percent, with a recurrence rate of 9 to 50 percent [48]. Adverse effects, such as hypopigmentation, telangiectasia, and thinning and atrophy of the skin, subcutaneous tissue and fat, were reported in about 20% of cases [46]. The effect of steroids can be increased by combining with other therapies, such as surgery or cryotherapy [4,49,50]. An intralesional triamcinolone injection is the second-line therapy for the treatment of hypertrophic scars [4,10,50].

5-Fluorouracil (5-FU)

5-FU is one of the oldest chemotherapy agents, and a pyrimidine analog. It has been used against many malignancies [5,10,51]. 5-FU has an inhibitory effect on human fibroblast cells [52]. Intralesional 5-FU for hypertrophic scarring is found to be well-tolerated and carries a minimal risk of serious side effects. The side effects were erythema, swelling, pain, molting, pigmentation, and occasional ulcers. To reduce side effects, low-dosed cocktail therapy is currently being used [1]. 5-FU can use 50 mg/mL once to twice a week initially, followed by injections at intervals of 4 to 6 weeks with or without triamcinolone. An interval between two injections should be decided by judging the induration and inflammation of the lesions [5]. It may warrant further investigation and wider use as an alternative to steroid injections in difficult-to-treat patients [4].

Liu et al. proposed tissue remodeling as a new antiscarring approach, which aims to reorganize an existing scar into a tissue structure, approaching normal skin without the need for creating a new wound and going through the healing process [53]. Of note, such an approach might be feasible for a clinical application based on one's own clinical observation. In an interesting case of keloid on the chest, they have injected a low dose of 5-FU along with a steroid to inhibit angiogenesis and fibroblast proliferation as well as to gradually degrade collagen matrices. At a later stage, an even lower dosage of both drugs was injected into already flattened and partially remodeled scar tissue. To their surprise, the peripheral area of the treated keloid gradually revealed a normal-looking skin appearance, with difficulty in defining the original scar boundary [53,54]. Later, several other similar cases were also found in their practice. The presence of such an interesting phenomenon may suggest that complete remodeling of an existing scar to a normal skin structure is likely to occur if an efficient method is provided to enhance this process. Although the concept is illustrated using keloid remodeling as an example, this approach is more likely to be applied to the remodeling of a normal scar [53].

Bleomycin

Bleomycin isolated from the Streptomyces verticillus is used for treating various kinds of malignancy as an antitumor agent [10]. In addition, bleomycin is used for hypertrophic scar treatment, especially in patients with older scars resistant to intralesional corticosteroids [55]. The rationale for use of bleomycin is similar to 5-FU, which is another chemotherapeutic agent [4]. Various studies reported more than 80% improvement in cases of hypertrophic scars and keloids after intralesional bleomycin treatment [55,56]. The side effects of bleomycin are relatively less, and the most common complications were reported as ulcerations and hyperpigmentation [57,58].

Interferon

Although interferon- α , interferon- β , and interferon- γ increase collagen breakdown, interferon- α 2b has been used in clinical practice for scar treatment [51,59,60]. Interferon- α 2b has been effective in reduc-

ing collagen and TGF- β production by activated hypertrophic scar fibroblasts, and in increasing collagenase activity. It was reported that the significant improvement of hypertrophic scars was observed after interferon- α 2b injections three times weekly [61]. Regional anesthesia may be required for interferon injections, since the procedure is painful [4].

Laser

Laser therapy shows promise in treating cutaneous scars by means of development of laser technology [62]. Laser treatment of hypertrophic scars, which began with the carbon dioxide (CO2), argon, and Nd:YAG lasers, has been used for non-specific destruction of tissue to produce less scarring [10,63]. These lasers were used for the management of hypertrophic scars and keloids, but subsequent studies showed that long-term results were not successful and recurrence rates were very high, although Acikel et al. reported successful results with a CO2 laser for camouflage of self-inflicted razor blade incision scars to a socially acceptable appearance similar to a burn scar [4,10,64].

Lately, flashlamp-pumped pulsed-dye lasers have been tried successfully for softening and flattening the lesions [4,5]. Improvement rates of hypertrophic scars and keloids have been reported as 57-83% of cases with a pulsed-dye laser [65]. In addition, it was reported that the combination of a pulsed-dye laser and intralesional corticosteroid provided further improvements [66]. However, Wittenberg et al. reported that reductions in blood flow, volume, and pruritus are no different in control and flashlamp-pumped pulsed-dye laser-treated sections of the scars in their randomized, controlled study. They also reported that the improvements observed in several other studies may have been secondary to normal hypertrophic scar regression [67]. It is shown that further controlled studies of the effects of flashlamp-pumped pulsed-dye laser treatment on hypertrophic scars need to be performed.

Cryotherapy

Freezing the scars with liquid nitrogen can yield significant improvement or even complete regression of hypertrophic scars [10,68]. Compared to laser therapy, cryotherapy is a very effective method [10]. However, there are some serious limitations to cryotherapy, such as permanent hypopigmentation, hyperpigmentation, moderate skin atrophy, and pain. In addition, cryotherapy is limited to the management of very small scars, and several weeks are required for postoperative healing. Better results have been obtained with cryotherapy combined with intralesional triamcinolon injections [10]. An intralesional needle cryoprobe method for the treatment of hypertrophic scars has been developed to avoid the many drawbacks associated with the classical cryotherapy [10,68].

Adhesive Microporous Hypoallergenic Paper Tape

The mechanism of the benefit of microporous paper tape is not clear, but the authors have a consensus about efficacy of the application of paper tape for prevention of hypertrophic scars [4,69,70]. The mechanism of action may in part be mechanical (as a pressure dressing) and occlusive (as a silicone gel therapy). It seems to be useful in treating fresh surgical incision, especially as preventive treatment, or it may be useful for scars over mobile or complex surfaces, including joints [4].

Popular Treatments

Vitamin E

Vitamin E is the major lipid-soluble antioxidant in the skin, and is very popular among the public for skin care. Although many physicians believe it decreases scar formation by means of inhibit fibroblasts and keratocytes, there is little evidence from well-controlled and randomized clinical trials to justify its benefits for surgical scars [10,26,71-73]. In the past, there were some negative studies reporting that vitamin E didn't reduce scar formation; conversely, it resulted in an increased incidence of contact dermatitis [74,75]. Most recently, Khoo et al. performed a prospective, randomized, double-blinded study with 5% tocotrienol, subfamilies of vitamin E, on 122 patients with recently healed (< 2weeks) surgical scars. They found that twice-daily application of 5% tocotrienol had no significant effect on the appearance and vascularity of scars over 4 months post-surgery. In addition, the most interesting finding in their study was the absence of adverse effects, except for minor itchiness [71].

In contrast to the above-mentioned studies, the positive effect of topical vitamin E (tocopheryl acetate) on surgical scars was recently shown in a prospective

single-blinded study of 428 children. The topical vitamin E was applied at least 15 days before and 30 days after elective inguinal surgery. The authors attributed the improvement in cosmetic results to the preoperative application, which was presumed to cause skin rehydration, improve elasticity and resistance and cause quicker physiologic healing [71,76].

The combination of vitamin E and other therapies may yield positive results. Vitamin E used in combination with silicone gel sheets improved the quality of pre-existing hypertrophic scars and keloids, as compared with silicone gel sheets alone after 2 months, as was noted in a simple-blinded study [71,76]. This was attributed by the authors to the synergistic effect of the two topical treatments, rather than vitamin E alone. In another study involving 15 patients with keloids and hypertrophic scars in high predisposition areas of the body, the combination of 0.5% hydrocortisone, silicone and vitamin E lotion was noted to be superior to onion extract and the placebo [71,77]. Further research is needed before the application of topical vitamin E [10].

Onion Extracts

Transforming growth factor- β (TGF- β) is a multifunctional protein that plays an important role in regulating cellular growth, differentiation, adhesion, and apoptosis in many biologic systems [11-13,78]. TGF- β inhibits the growth of most cell types. In addition, TGF- β causes the deposition of the ECM [13,78] by simultaneously stimulating skin fibroblasts to increase the production of ECM proteins, such as collagen, fibronectin, and proteoglycan, to decrease the production of matrix-degrading proteases, to increase the production of inhibitors of these proteases, and to modulate the expression of integrins [12,13,78]. TGF- β 1 is the most fibrogenic isoform of TGF- β [14,78].

Topical onion extract, including heparin and allantoin, is a well-known ointment in routine outpatient practice, claimed to be effective in the prevention and treatment of hypertrophic scars [10,35,79,80]. Onion extracts, including quercetin and kampferol, have fibroblast-inhibiting properties, which reduce both proliferative activity and the production of extracellular matrix [10]. Quercetin also produces a significant reduction in transforming growth factor beta (TGF- β) expression in fibroblast [10,81,82]. Heparin affects both dermal fibroblast proliferation and interacts strongly with collagen molecules [35], and may mediate these effects by altering the levels of transforming growth factor- β 1 (TGF- β 1) production and TGF- β 1 mRNA expression as a wound-healing modulator. Studies have shown that heparin causes a decrease in collagen production by fibroblasts [78]. Thus, heparin induces the formation of thicker fibrils, typical of a mature tissue, and also promoted intermolecular bonding in collagen [80], and so heparin and onion extract affected scar development by their inhibitory effects on inflammatory processes, fibroblasts [10,35].

Some articles reported significant improvement in the appearance of scars treated with onion extract, heparin and allantoin [35,79,80]. In our most recent study, we assessed the efficacy of topical onion extract, including heparin and allantoin, and compared to silicone gel and silicone gel sheeting [35]. We found that there was a statistically significant difference between before and after treatment with topical onion extract, but topical onion extract was less effective than the others, when compared to silicone gel and silicone gel sheeting.

Physical Therapy Treatments

Hydrotherapy, massage, ultrasound, static electricity, and pulsed electrical stimulation are physical therapy methods used for the treatment of hypertrophic scars. Hydrotherapy and massages have been especially and widely used by physical therapists [4]. A manual or mechanical massage is standard therapy in rehabilitation centers specializing in the treatment of scars and burns [83]. It was reported that massage therapy increased scar pliability and decreased scar banding [84].

Combination of Surgery and Adjuvant Therapy

Intractable recurrent hypertrophic scars should be treated according to the keloid treatment algorithm suggested by Ogawa, where the combination of surgery and adjuvant therapy is the treatment of choice [6,85,86]. Hypertrophic scars, although more responsive than keloids to appropriate surgery, also frequently require adjuvant treatment. A combination therapy (such as surgery, corticosteroids, surgical taping and silicone gel sheeting) can be used more effectively in preventing hypertrophic scars, which result from excessive tension or wound complications, such as infection or delay in healing, than any single treatment [4]. For small scars, surgical excision and corticosteroids are appropriate therapy. For moderately large scars, pressure therapy should be added to the surgery-steroid combination. For very large, treatment-resistant scars, the best results are reported with a combination of surgery and postoperative radiotherapy [7].

Conclusion

A lot of therapeutic modalities have been described for the hypertrophic scars so far, and most of them are reported that one's own self is effective. However, there are less randomized, controlled trials. Consequently, most of the reports are anecdotal, and they don't consider or ignore that all scars improve with time. Therefore, most modalities are applied on the basis of the personal experiences.

Recently, some articles, which were prepared by considering mostly the evidence-based studies, have been published and include the algorithms for management of hypertrophic scars [4,6,10]. We tried to consider these articles and the other randomized, controlled studies when we prepared this review. In the light of the knowledge mentioned in this review and of our personal experiences, we can give some recommendations for physicians who try to treat or prevent the hypertrophic scar:

1. It is much more efficient to prevent hypertrophic scars than to treat them. An intensive effort must be made to prevent the development of hypertrophic scars after an injury. Careful wound care and meticulous surgical repair without tension of the wound are the most important.

2. Preventive therapy should be applied after the wound has fully epithelialized, if there is no disability. Compression therapy with pressure garments should be used for epithelialized wounds, which have risk of scarring if it is applicable. Hypoallergenic microporous tape with elastic properties can minimize the risk of shearing.

3. Onion extracts or silicone gel may be used for a few months in low-risk groups, but silicone gel sheeting should be considered as first-line prophylaxis in high-risk groups, and continued for at least 1 month. Concurrent intralesional corticosteroid injections may be applied as second-line prophylaxis for more severe cases.

4. If a hypertrophic scar develops or erythema continues for more than 1 month in spite of prophylaxis, a treatment program should be applied. Silicone gel sheeting combined with pressure therapy should be used firstly.

5. If the scar is resistant to silicon gel sheeting, intralesional corticosteroid injections can be used and should be repeated monthly until they achieve the desired result. Other second-line therapeutic modalities, such as intralesional 5-FU, or bleomycin injections, laser therapy, and radiotherapy, can be used when considering the knowledge mentioned in the article for severe cases.

6. Hypertrophic scars, which include a contracture band and which cause dysfunction, must be treated primarily by surgery after maturation, and then the other treatment methods can be applied, as mentioned above.

7. All of these treatment and prevention methods can be used alone or combined with the others. Whichever method is used, it should be combined with pressure treatment as far as we are concerned.

It should be mentioned again that our recommendations mostly depend on current literature and our personal experiences, and are created to guide physicians who try to treat the hypertrophic scar. We tried to concern the controlled, randomized studies as much as possible. The therapist should select the most appropriate method or methods according to the patient's needs and properties of the scar.

Conflict of interest statement

The authors do not declare any conflict of interest or financial support in this study.

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